

TRADE OFF BETWEEN INVESTMENTS IN WARFIGHTING SYSTEMS AND INVESTMENTS IN INFRASTRUCTURE

A Conceptual Framework

Alfred Kaufman
Institute for Defense Analyses

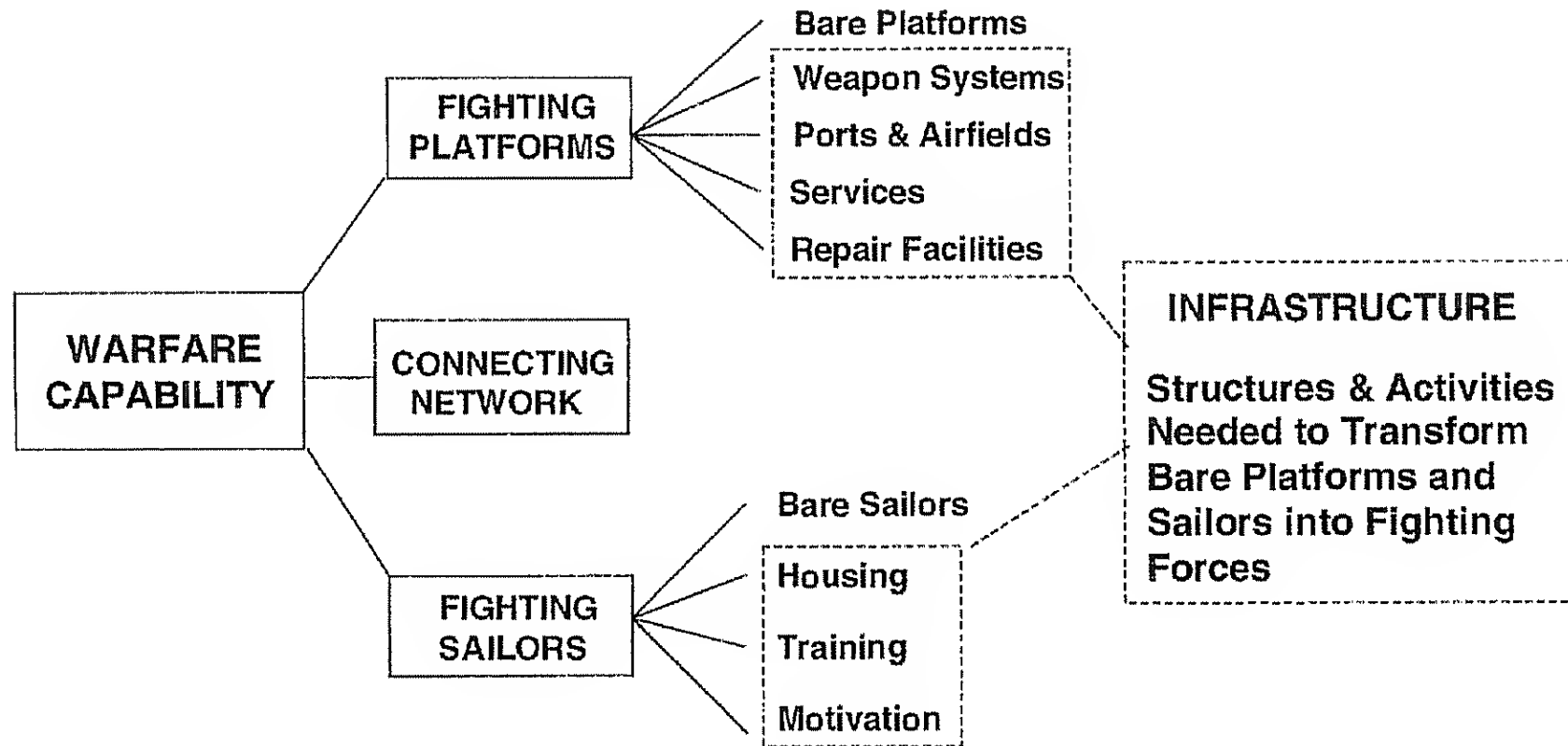
THE CHALLENGE

- **THE IWAR PROCESS CREATED IMPETUS FOR AN END-TO-END CAPABILITY ANALYSIS THAT WOULD**
 - **Cut Across Platforms to Capture Capability**
 - **Integrate Warfighting with Supporting Elements**
- **HOWEVER, THE SUPPORT AND THE WARFIGHTING COMMUNITIES HAVE SLOWLY DRIFTED APART**
 - **Warfighting Community is Focused on Platforms and Tacitly Assumes the Infrastructure Is There**
 - **Support Community is Focused on Managing the Infrastructure and Tacitly Assumes it to be Useful**
- **THEREFORE, TO IMPLEMENT IWAR, WARFIGHTING AND INFRASTRUCTURE MUST BE RECONNECTED**

WHAT IS INFRASTRUCTURE?

- **BEFORE CONNECTING IT TO WARFIGHTING, WE MUST FIRST DECIDE WHAT INFRASTRUCTURE IS**
- **CURRENT DEFINITIONS ARE NOT ILLUMINATING**
 - **They Either Characterize Infrastructure by Features that are not Relevant to Warfighting, Such As the Relation of Structures to Land**
 - **Or Reduce it to a Mere Listing of Structures**
- **MUST FIND A DEFINITION OF INFRASTRUCTURE THAT DISPLAYS ITS RELATION TO WARFIGHTING**
 - **What Class of Things Does it Belong to**
 - **What Differentiates it from All the Other Members in the Class to Which it Belongs**

TAXONOMY OF NAVAL WARFARE

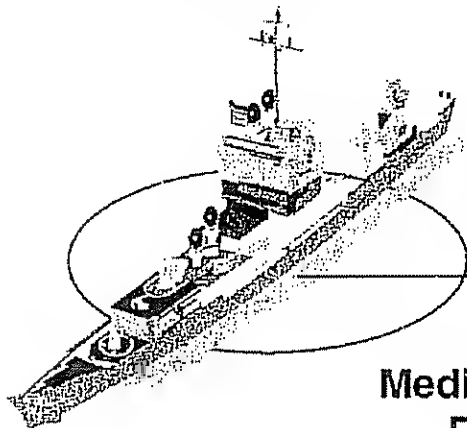
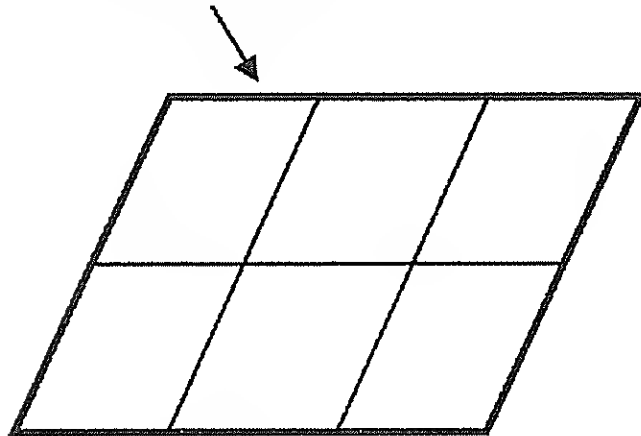


THE GUIDING IDEA

- **THE EXISTENCE OF AN INFRASTRUCTURE IS THE BASIC CONDITION OF ANY WARFARE CAPABILITY**
- **ANALYTIC ESTIMATES OF WARFARE CAPABILITY MUST MAKE THAT CONDITIONALITY EXPLICIT**
 - **Display the Effect that Various States of Infrastructure Have on Warfare Capability**
 - **Incorporate the Likelihood of Those States**
- **WARFARE CAPABILITY AVERAGED OVER INFRASTRUCTURE STATES IS THE LINCHPIN OF IWAR**
 - **Connects System Performance Parameters to Elements of the Infrastructure**
 - **Provides a Way of Trading Investments in Systems for Investments in Infrastructure**

PRECURSOR ASW: AN EXAMPLE

AREA OF CARRIER
OPERATION



Median Detection
Range

**WARFARE DOMAIN: ALLIED
DOMINANCE OF THE SEA**

- Offensive/Defensive MIW
- SUW Superiority
- ASW Superiority

**SET-PIECE BATTLE: PRE-
CURSOR ASW OPERATION**

Sanitize the Carrier Battle
Group Operating Area in
Preparation for its Arrival

CONCEPT OF OPERATION:

- A number of ASW Ships, each with a Given Median Detection Range, Search the Area 48 hrs
- Thereafter, any Surviving Submarine Gets a Chance to Attack the Carrier

MAKING INFRASTRUCTURE EXPLICIT

A. MOE FOR SET- PIECE BATTLE

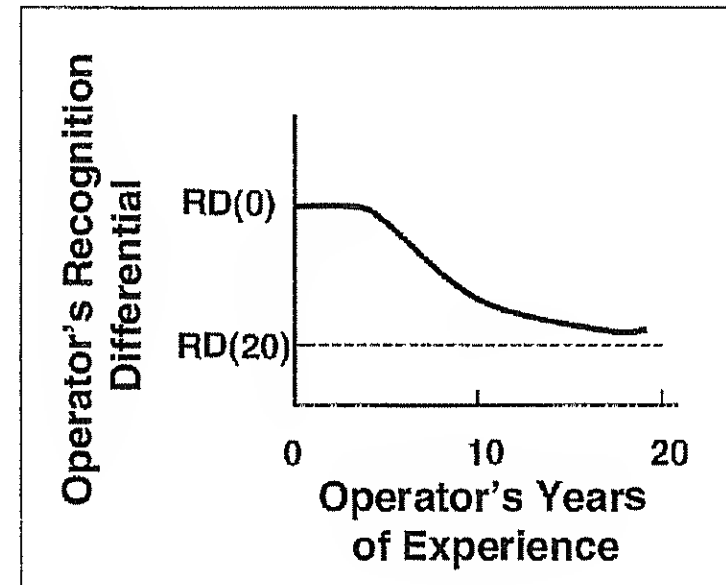
Probability Carrier is Attacked
by Enemy Submarine after n
Ships have Conducted 48 Hrs
of Precursor ASW

B. MOE FOR ASW SHIP

Probability that the Ship Fails
to Disable Enemy Submarine

1. MOE for ASW Ship Depends
on the Median Detection
Range of the Ship's Sonar
2. The MDR Depends on the
Recognition Differential of
the Sonar Operator
3. The Operator's RD Depends
on Random State of his
 - Performance out of School
 - Years of Fleet Experience

ANECDOTAL EVIDENCE



CONNECTING TO INFRASTRUCTURE

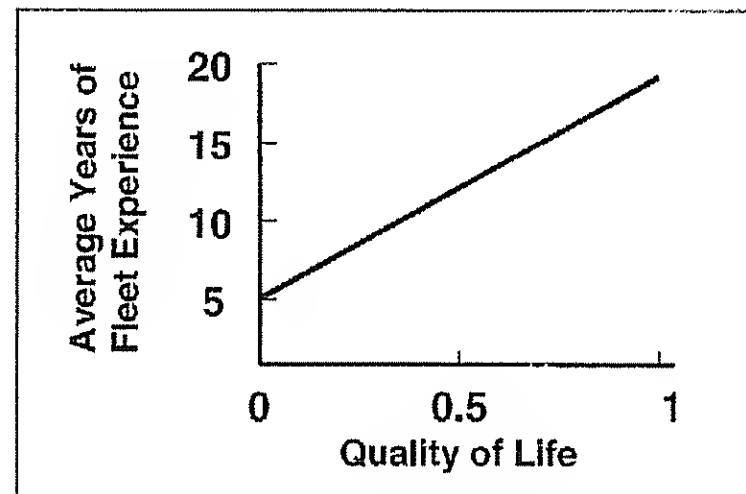
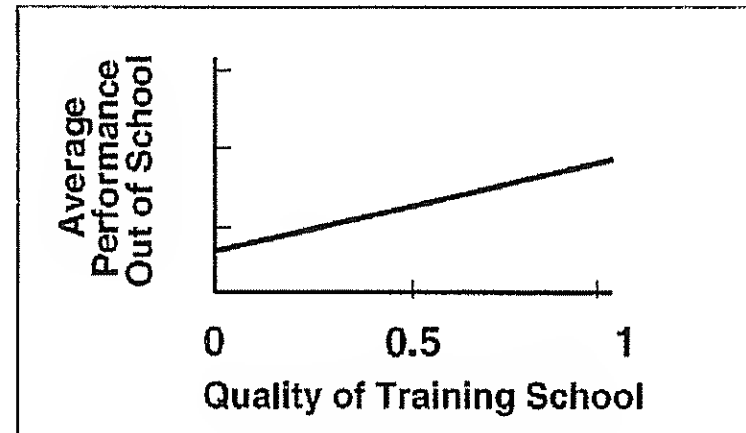
C. ALTHOUGH THE OPERATOR IS CLEARLY A PRODUCT OF THE INFRASTRUCTURE, THE QUALITY OF HIS PERFORMANCE IS NOT A DIRECT FUNCTION OF IT

- He may be the Low Performer in an Otherwise Excellent Training Class
- He may be the Exception that Decided to Stay in the Navy Despite Inadequate Quality of Life Conditions

D. WHAT DOES DEPEND DIRECTLY ON THE INFRASTRUCTURE ARE THE STATISTICAL PROPERTIES OF THE RANDOM OPERATOR QUALITY

- The Average Operator Quality
- The Variance About That Average

ANECDOTAL EVIDENCE



CONTRIBUTION TO WARFIGHTING

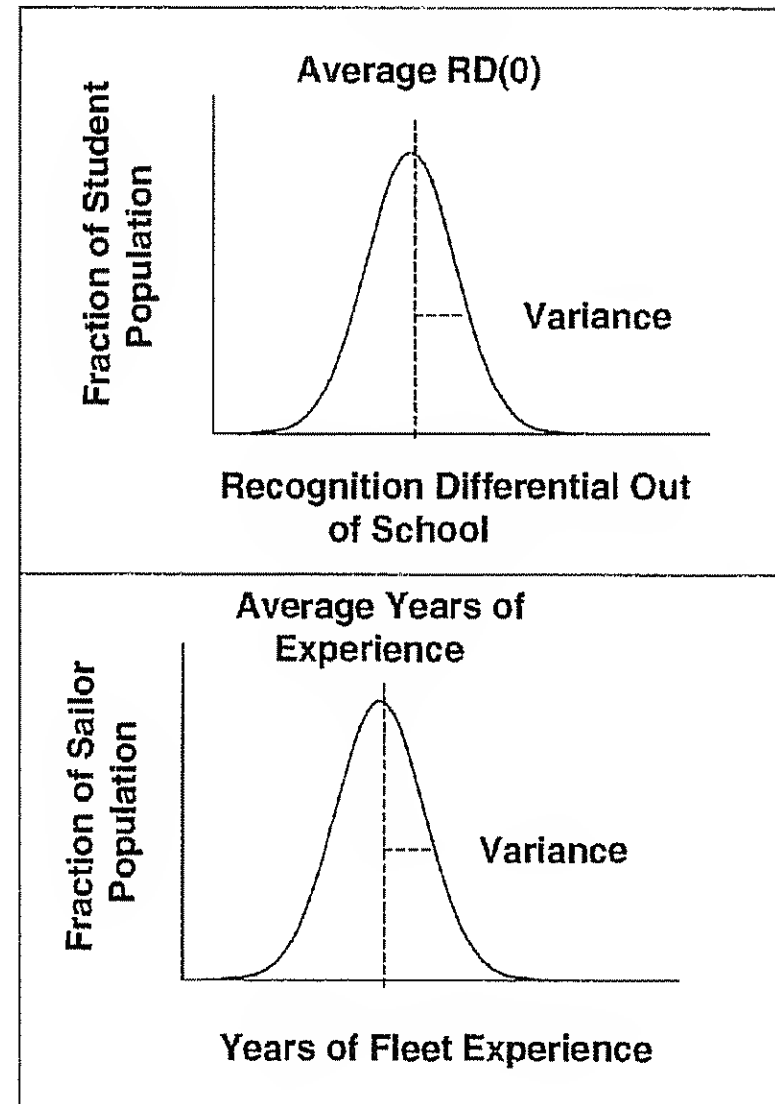
E. IT IS THEN NATURAL TO MEASURE INFRASTRUCTURE CONTRIBUTION TO WARFIGHTING IN TERMS OF THE

- Probability Distribution Over the Operator Quality it has Produced
- Moments of that Distribution

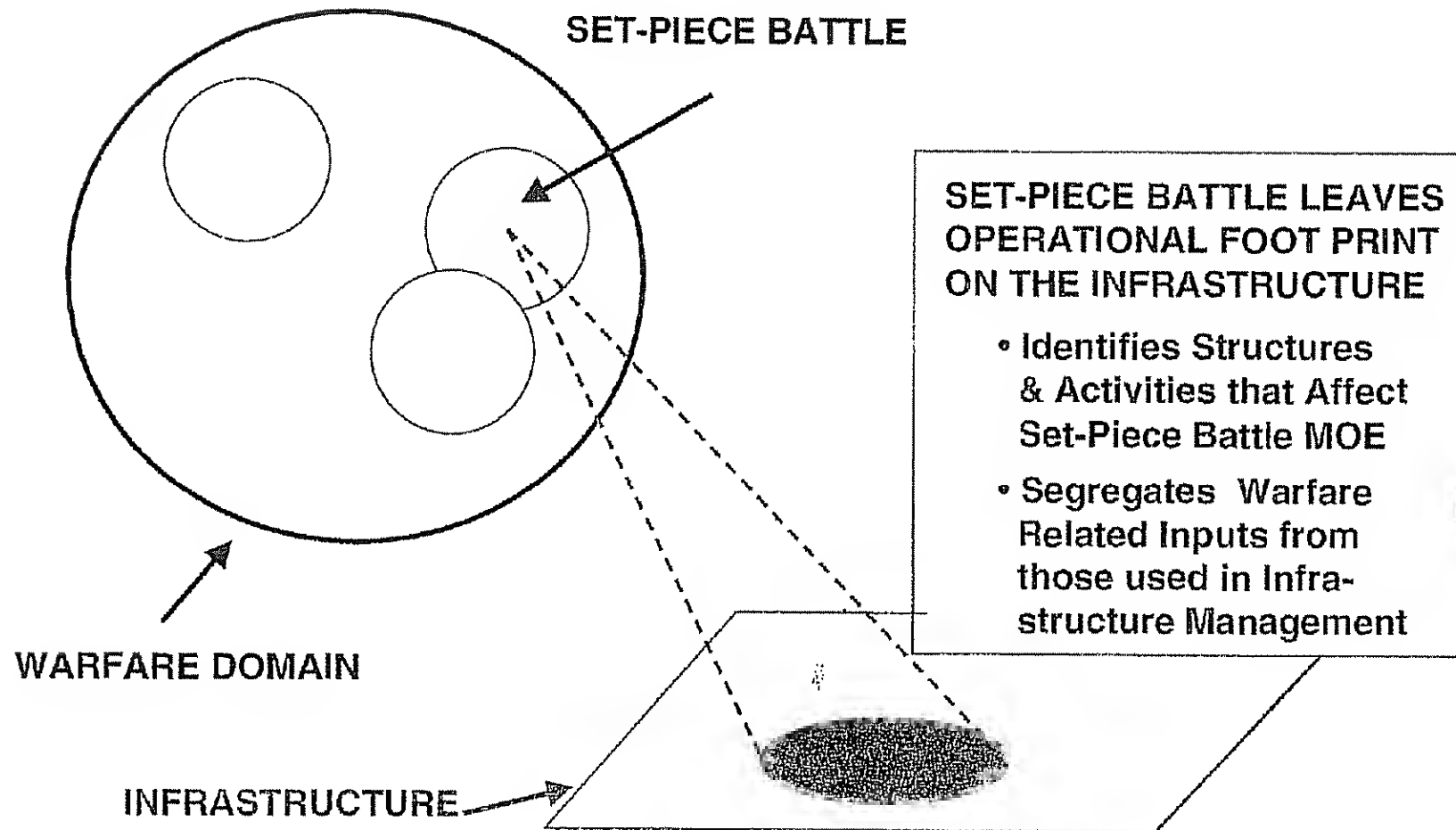
F. THESE MEASURES DIFFER FROM THOSE ONE WOULD EMPLOY IN MANAGING THE INFRASTRUCTURE

- The ⁺Later are Designed to Capture the *Operation* of the Structures and Activities Involved
- The Former Captures the *Output* of these Structures and Activities that Directly Affect Warfighting

G. HOWEVER, BOTH ARE NEEDED TO RUN A SUCCESSFUL NAVY



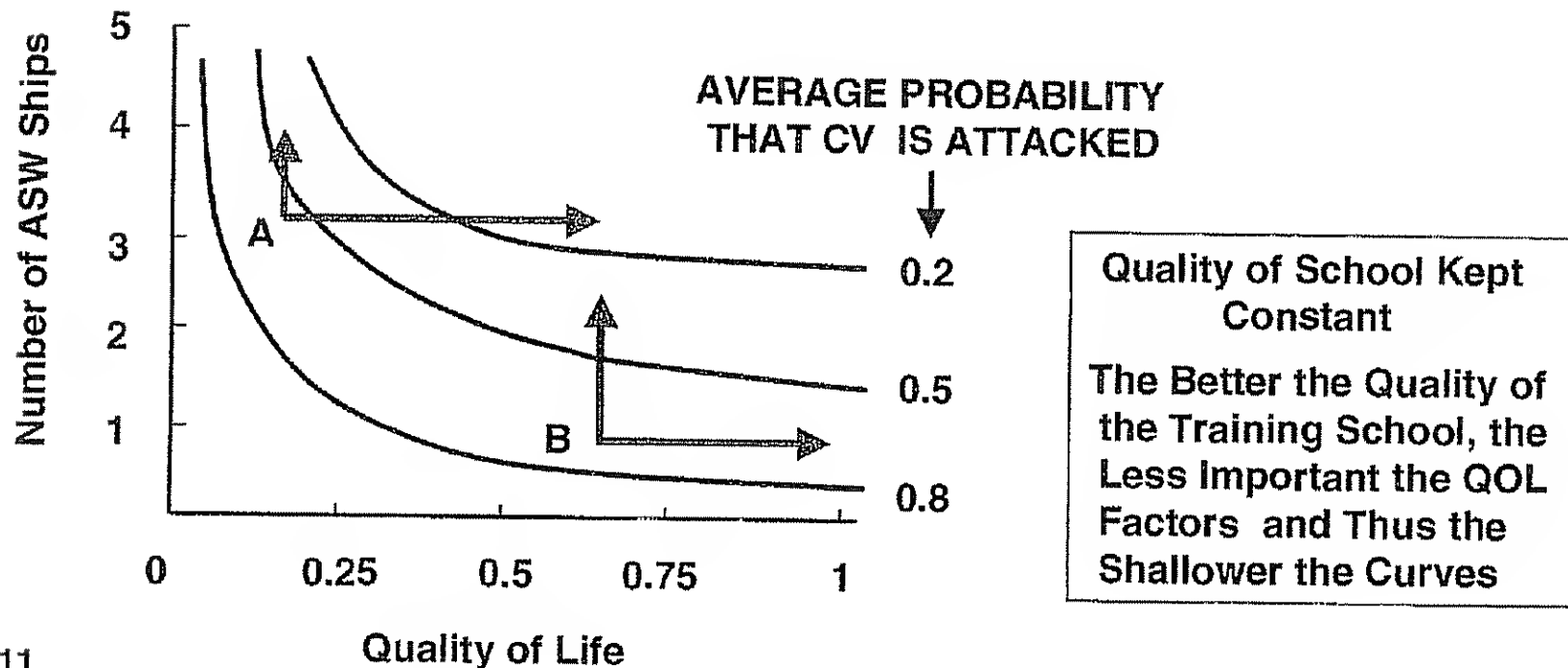
EMERGING PICTURE



TRADE-OFF BETWEEN EQUAL-COST INVESTMENTS

LINCHPIN: PROBABILITY OF ATTACK AGAINST THE CARRIER, AVERAGED OVER THE VALUE OF THE OPERATOR'S RECOGNITION DIFFERENTIAL, DEPENDS ON THE

- Number of ASW Ships Employed
- Quality of Training School
- Quality of Life Offered by the Navy



POTENTIAL BENEFITS OF THIS APPROACH

- 1. STARTS WITH WARFARE, NOT INFRASTRUCTURE**
- 2. GENERATES WARFARE ORIENTED ORDERING OF INFRASTRUCTURE ELEMENTS**
- 3. THIS ORDERING OF ELEMENTS SUGGESTS**
 - A Natural Way to Measure Contribution of Naval Infrastructure to Warfighting**
 - Specific Data Collection Requirements**
- 4. MEASURES CURRENT DISBALANCE BETWEEN WARFARE AND INFRASTRUCTURE**
- 5. PROVIDES TOOL FOR INVESTMENT TRADE- OFF BETWEEN SYSTEMS AND INFRASTRUCTURE**